

## Digenetic Trematodes of Marine Fishes from the Kuwaiti Coast of the Arabian Gulf: Families Pleorchiidae, Fellodistomidae, and Cryptogonimidae, with a Description of Two New Species, *Neoparacryptogonimus sphericus* and *Paracryptogonimus ramadani*

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**ABSTRACT:** Six digeneans are reported from marine fishes of the Kuwaiti coast of the Arabian Gulf: *Pleorchis sciaenae* Yamaguti, 1938, from *Otolithes argenteus*; *Tergestia pauca* Freitas and Kohn, 1965, from *Scomberoides commersonianus* and *Trachurus trachurus*; *Allobacciger macrorchis* Hafeezullah and Siddiqi, 1970, from *Scolopsis ruppelli* (new host record); *Paradiscogaster farooqii* Hafeezullah and Siddiqi, 1970, from *Scatophagus argus*; *Neoparacryptogonimus sphericus* sp. n. from *Lutjanus coccineus* (type host) and *Batrachus grunniens*; and *Paracryptogonimus ramadani* sp. n. from *Lutjanus fulviflamma*. *Pleorchis arabicus* Al-Yamani and Nahhas, 1981, is a synonym of *P. sciaenae*. *Tergestia pectinata* of Nahhas and Cable (1964), Nahhas and Short (1965), is considered a synonym of *Tergestia pauca*. New locality records are established for *Tergestia pauca*, *Allobacciger macrorchis*, and *Paradiscogaster farooqii*. A key to species of *Paracryptogonimus* and *Neoparacryptogonimus* is given.

**KEY WORDS:** Arabian Gulf, Kuwait, marine fishes, *Otolithes argenteus*, *Scomberoides commersonianus*, *Trachurus trachurus*, *Scolopsis ruppelli*, *Scatophagus argus*, *Lutjanus coccineus*, *Lutjanus fulviflamma*, *Batrachus grunniens*, Digenea, *Pleorchis*, *Tergestia*, *Allobacciger*, *Paradiscogaster*, *Paracryptogonimus*, *Neoparacryptogonimus*.

During the course of a survey of helminth parasites of the Kuwaiti coast carried out by the second author between 13 June 1992 and 19 December 1996, a large number of digeneans representing several families were obtained. This paper reports 1 known species of pleorchiid and 3 fellodistomids and describes 2 new cryptogonimids from 8 species of fish. Previous surveys on adult digeneans of the Arabian Gulf have been conducted in coastal waters of 3 countries: Kuwait (Al-Yamani and Nahhas, 1981; Abdul-Salam and Khalil, 1987; Abdul-Salam et al., 1990; Abdul-Salam and Sreelatha, 1992, 1993; Sey, 1995; Sey and Nahhas, 1997); Qatar (Saoud et al., 1986a, b, 1987, 1988a, b, c); and the United Arab Emirates (El-Naffar et al., 1992). Despite the seemingly large number of published articles, the digeneans of the Arabian Gulf remain poorly known considering the great diversity of the fish (Kuronuma and Abe, 1986; Randall, 1995) and potential molluscan intermediate hosts (Glazyer et al., 1984).

### Materials and Methods

A total of 698 fishes representing 86 species, in 76 genera and 44 families, were obtained from the local

fish market and examined. The worms were fixed, stained, and mounted according to standard techniques as described by Sey and Nahhas (1997). Measurements are expressed in micrometers; length followed by width is indicated as a range; the mean, in parentheses, is calculated for all species represented by 3 or more specimens. Drawings were prepared by microprojection, and details were filled in through microscopic observations. Calculations of prevalence, mean intensity, and abundance follow the recommendations of Margolis et al. (1982) and are indicated, with dates of collection, in Table 1. A \* preceding a host indicates a new host record, \*\* a new synonym. Holotypes are deposited in the National Reference Collection (NRC), Department of Biological Sciences, Kuwait University, Kuwait. Paratypes or vouchers are in the United States National Parasite Collection (USNPC), Beltsville, Maryland; The Natural History Museum BM(NH), London; and Harold W. Manter Laboratory (HWML), University of Nebraska State Museum, Lincoln, Nebraska. Fishes were identified using Kuronuma and Abe (1986).

### Results

#### Pleorchiidae

##### *Pleorchis sciaenae* Yamaguti, 1938

**SYNONYM:** *Pleorchis arabicus* Al-Yamani and Nahhas, 1981.

**DESCRIPTION** (based on 5 specimens): Body broadly elongate, 3,425–6,500 × 1,250–1,930

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**Table 1. Prevalence, mean intensity, and abundance of digeneans found in 8 species of marine fish from Kuwait.**

Host*	% Prevalence	Mean intensity	Abundance	Collection date†
<i>Otolithes argenteus</i> (4/21)				12 October 1993 3 October 1994 5 March 1995 5 April 1996
<i>Pleorchis sciaenae</i>	19	4.5	0.8	
<i>Scomberoides commersonianus</i> (1/9)				21 June 1995
<i>Tergestia pauca</i>	11	2.0	0.2	
<i>Trachurus trachurus</i> (1/11)				10 November 1995
<i>Tergestia pauca</i>	9	2.0	0.18	
<i>Scolopsis ruppelli</i> (1/6)				15 October 1993
<i>Allobacciger macrorchis</i>	17	31	5.1	
<i>Scatophagus argus</i> (2/9)				13 June 1993 9 July 1993
<i>Paradiscogaster farooqii</i>	22	36.5	8.1	
<i>Lutjanus coccineus</i> (1/5)				25 January 1994
<i>Neoparacryptogonimus sphericus</i>	20	3.0	0.6	
<i>Batrachus grunniens</i> (1/12)				30 September 1995
<i>Neoparacryptogonimus sphericus</i>	8	2.0	0.18	
<i>Lutjanus fulviflamma</i> (1/4)				10 October 1995
<i>Paracryptogonimus ramadani</i>	25	19	4.7	

\* Number in parentheses next to host refers to number infected/number examined.

† Collection dates refer to date of collection of fish harboring those digeneans.

(5,430 × 1,696), widest at ovarian level. Forebody 30–36% (33%) of body length; hindbody 58–68% (66%). Tegument spinose; spines extending to near posterior end of body. Eye-spot pigments present. Oral sucker subterminal, 180–392 × 268–420 (314 × 362). Ventral sucker 205–300 × 220–300 (251 × 265), in anterior body fourth. Sucker ratio 1:0.66–1:0.86 (1:0.76). Prepharynx 160–310 (230) in length; pharynx 170–275 × 200–320 (238 × 275); esophagus short; intestinal bifurcation in anterior body fifth; ceca with short anteriorly directed limbs, extending to about midprepharyngeal level; posterior limbs to near posterior end of body. Testes in 4 columns, 2 ventral and 2 dorsal, each of 11 testes or 44 in total (1 worm had 48); cirrus sac dextrodorsal to ventral sucker, 560–900 × 125–200 (703 × 159), widest at base, containing ovoid seminal vesicle, elongate prostatic duct, and short aspinose cirrus. Ovary multilobed, 345–600 × 400–730 (400 × 600); uterus short, preovarian. Ovarian complex masked by ovary and testes. Vitelline follicles numerous, extending laterally, both dorsally and ventrally, from

anterior level of ventral sucker to posterior end of body, confluent posterior to testes. Eggs 65–75 × 37–42 (70 × 41). Genital atrium anterior to ventral sucker; pore median. Excretory vesicle tubular, arms extending to ovary; pore terminal.

HOST: *Otolithes argenteus* Cuvier and Valenciennes, 1830 (Sciaenidae).

SITE IN HOST: Intestine.

DEPOSITED SPECIMENS: NRC No. 20, USNPC No. 87742, BM(NH) No. 1998.3.6.1, HWML No. 39703.

REMARKS: Except for larger size and comparatively larger structures, these specimens are in agreement with Yamaguti's description. Al-Yamani and Nahhas (1981) described *P. arabicus* from a single specimen taken from the same host species and characterized it by a cirrus sac sinistral to the ventral sucker. A reexamination of the type (USNPC 75560) indicates that the authors had erred in their interpretation of the position of the cirrus sac; it partially overlaps the ventral sucker dorsally. In his description of *P. sciaenae*, Yamaguti (1938) described the cir-

rus sac as "extending over the acetabulum"; his figure showed one that is dorsal and slightly dextral to the ventral sucker. *P. arabicus* is here considered a synonym of *P. sciaenae*.

#### Fellodistomidae

##### *Tergestia pauca* Freitas and Kohn, 1965 (Fig. 1)

SYNONYMS: *Tergestia mauritanica* (Dollfus, 1973) Bray, 1984; *T. manteri* (Dollfus, 1973) Bray, 1984; *T. pectinata* (Linton, 1905) of Hopkins (1940); *T. pectinata* (Linton, 1905) of Manter (1947); *T. pectinata* (Linton, 1905) of Siddiqi and Cable (1960); \*\**T. pectinata* (Linton, 1905) of Nahhas and Cable (1964); \*\**T. pectinata* (Linton, 1905) of Nahhas and Short (1965).

DESCRIPTION (based on 2 specimens from *Scomberoides commersonianus*): Body elongate, 2,150–3,680 × 400–600. Forebody 26–32% of body length; hindbody 57–60%. Tegument aspinose. Eye-spot pigments absent. Oral sucker terminal, 165–210 × 168–220, bearing 12 appendages, each 60–90 × 31–35 in greatest width; neck region with 6 pairs of lateral cuticular processes, 3 at pharyngeal level and 3 more posteriorly, each bearing 1 or 2 filaments. Ventral sucker 300–450 × 350–423, in anterior third of body. Sucker ratio 1:1.95–1:2.03. Prepharynx short; pharynx cylindrical, 200–275 × 78–138; esophagus very long, sinuous, almost half body length in 1 well-extended specimen (Fig. 1), intestine bifurcating posterior to ventral sucker; ceca long, extending to near posterior end of body. Testes slightly oblique, near posterior extremity; anterior testis 300–330 × 220–240; posterior testis 350–370 × 180–240. Cirrus sac distinctly bipartite, anterior part globular, 140–220 × 140–190, containing small saccular internal seminal vesicle, short prostatic duct, and folded cirrus; posterior part 440–710 × 80–90, extending from anterior level of ventral sucker dorsally to short distance into hindbody, containing straight seminal vesicle; prostatic cells surrounding small segment at junction of both parts. Ovary weakly trilobed or kidney shaped, 250–260 × 130–170 wide, pretesticular, in posterior body third; Mehlis' gland ventrolateral to ovary; seminal receptacle of uterine type; uterine coils extending posteriorly to junction of testes and anteriorly to posterior level of ventral sucker; metratrum indistinct entering genital atrium at its base close to anterior margin of ventral sucker. Vitelline follicles small, indistinct, ex-

tending laterally from midlevel of anterior testis to near posterior level of ventral sucker in 1 specimen and to middle of ovario-acetabular level in another, confluent near posterior margin of ventral sucker in former but not latter. Eggs numerous, operculated, 17–20 × 10–14 (18 × 12). Genital atrium globular; pore median, opening short distance anterior to level of ventral sucker. Excretory vesicle concealed by testes; excretory canals extending to postpharyngeal region.

HOSTS: *Scomberoides commersonianus* Lacépède, 1801 (Carangidae); *Trachurus trachurus* Linnaeus, 1758 (Carangidae).

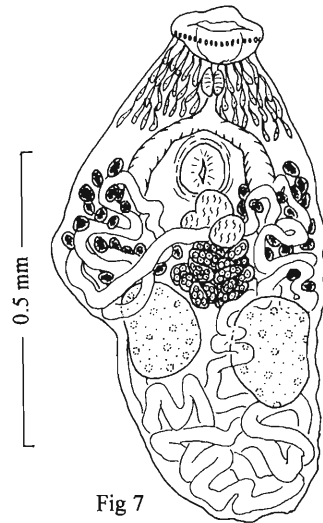
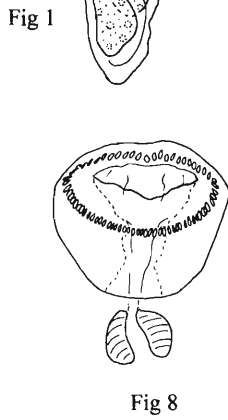
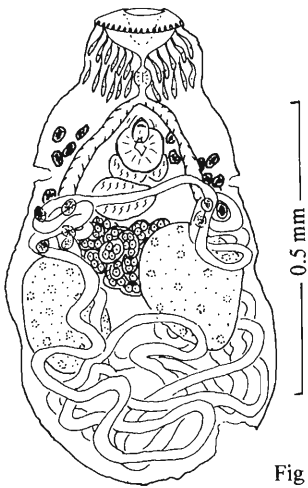
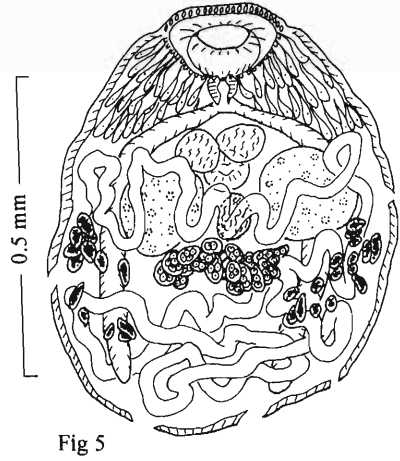
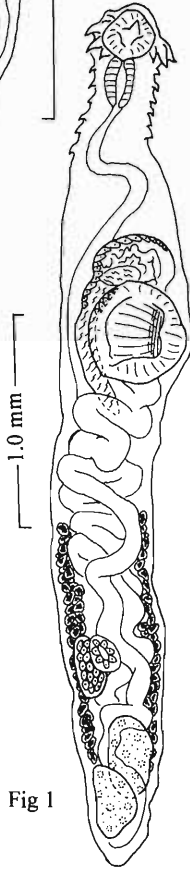
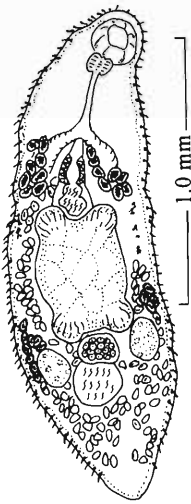
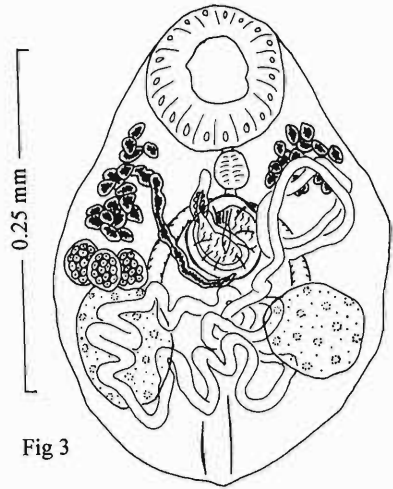
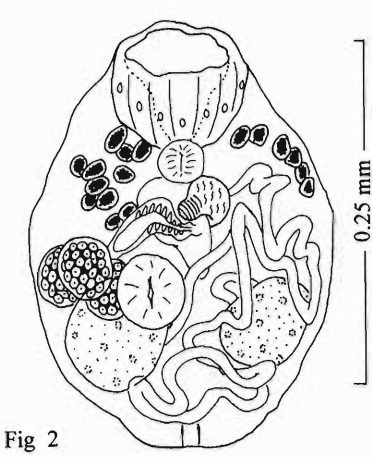
SITE IN HOSTS: Intestine.

DEPOSITED SPECIMEN: NRC No. 25.

REMARKS: The 2 specimens from *Trachurus trachurus*, the type host of *Tergestia laticollis*, included 1 with the oral sucker and pharynx missing and the other cut in half but with both parts present; these are also identified as *T. pauca* based on similarity in topography of the internal structures to those from *S. commersonianus*, except for a smaller size and larger sucker ratio. Measurements are body, 1,840 × 270; forebody, 32.6%; hindbody, 52.7%; oral sucker, 110 × 88; pharynx, 120 × 70; ventral sucker, 270 × 250; sucker ratio, 1:2.6; anterior testis, 220 × 150; posterior testis, 250 × 120; ovary, 200 × 90; and eggs, 15–18 × 12–13.

Specimens from both hosts agree well with the original description of Freitas and Kohn (1965) and Bray (1984) but differ in having somewhat more posterior ovary and testes. We could count only 12 oral processes in specimens from *S. commersonianus* and 11 in 1 from *T. trachurus*, suggesting uncertainty in determining accurately the number of processes when whole mounts are not properly oriented on slides and only a small number of specimens are available for study. The specimens from both hosts show 2 oblique overlapping testes very near the posterior end of the body. This extreme posterior location of the testes has not been reported, to the best of our knowledge, in those species we accept as, or consider synonyms of, *T. pauca*. We prefer, however, not to name a new species based on this single characteristic. This finding represents a new locality record.

Dollfus (1973) renamed *Tergestia pectinata* of Hopkins (1940), Manter (1947), and Siddiqi and Cable (1960) *T. manteri* and described *T. mauritanica*. He listed egg size for *T. pauca* but



did not compare it with the new taxa. Bray (1984) considered Dollfus' species synonyms of *T. pauca*. Neither Dollfus (1973) nor Bray (1984) made reference to *T. pectinata* of Nahhas and Cable (1964) or Nahhas and Short (1965) from various species of fish. Identification of the Jamaican and Floridian material as *T. pectinata*, at that time, was based on a comparison with Manter's and Siddiqi and Cable's material. We have reexamined several specimens in the collection of the first author from *Selar crumenophthalmus* from Jamaica and from *Bairdiella chrysura* from Apalachee Bay, Florida; there is no evidence of bifurcation anterior to the ventral sucker. We have no specimens from the other hosts to reexamine and no record of where they might be; the specimens from these hosts, as well as those from the other hosts (Nahhas and Cable, 1964; Nahhas and Short, 1965), should also be considered *T. pauca*. The sucker ratio of these specimens is 1:2.0–1:2.5; the ratio of pharyngeal length to width is about 2:1, and the position of the testes is like that shown by Manter (1947, fig. 85). One of the features of the Jamaican and the Floridian specimens is the presence of several muscle fibers around the opening of the ventral sucker, also shown in Manter (1947, fig. 85); these fibers seem to be less conspicuous in Freitas and Kohn's (1965) figure 1.

Several species in the *Tergestia*–*Theledera*–*Tergestina* group have been described to date. Dollfus (1973) did not include *Tergestina* Nagaty and Abdel Aal, 1964, in his review; he suggested recognizing 1 genus, *Tergestia* Stossich, 1899, with 2 subgenera, based on the location of the intestinal bifurcation: *Tergestia* (postacetabular) and *Theledera* Linton, 1910 (preacetabular). Bray and Gibson (1980) recognized the 2 taxa as genera, a position with which we concur. *Tergestina* was erected by Nagaty and Abdel Aal (1964) for *Tergestia*-like species with a true seminal receptacle and intercecal uterus not extending posterior to the testes. All 3 species

in this genus (*T. abuserai* Nagaty and Abdel Aal, 1964, *T. plataxi* Nagaty and Abdel Aal, 1964, and *T. synganathusi* [sic] Gupta and Tandon, 1985) meet these criteria and all, like *Theledera*, have a preacetabular intestinal bifurcation. The preacetabular position of the intestinal bifurcation led Bray (1984) to transfer Nagaty and Abdel Aal's species to the genus *Theledera*; no species of *Theledera*, however, has a true seminal receptacle, and the only species of *Tergestia* reported to have one is *T. bengalensis* Gupta and Singh, 1985, which was described from a single specimen. If generic significance is to be accorded a seminal receptacle, then *T. bengalensis* should be transferred to a new genus. Bray and Gibson (1980) apparently placed greater importance on the location of the intestinal bifurcation than presence or absence of a true seminal receptacle. When we reviewed the Florida and Jamaica *Tergestia* material, we found 1 specimen of *T. acuta* that seemed to have a saclike seminal receptacle. Its location was almost midway between the ovary and the ventral sucker, and no connection to Mehlis' gland–ootype complex was seen. We interpret this as a swollen part of the uterus that can conceivably be mistaken for a true seminal receptacle.

***Allobacciger macrorchis*  
Hafeezullah and Siddiqi, 1970  
(Figs. 2, 3)**

DESCRIPTION (based on 31 specimens, 1 sectioned; measurements on 12): Body ovoid, 280–450 × 180–280 (351 × 229), widest at level of testes. Forebody 38–44% of body length; hindbody 46–54%. Tegument spinose; most spines lost but few seen in posterior end of body. Eye-spot pigments absent. Oral sucker terminal to subterminal, 67–102 × 75–111 (86 × 99). Ventral sucker 38–56 × 38–61 (48), near midbody. Sucker ratio 1:0.48–1:0.59 (1:0.52). Prepharynx very short; pharynx 35–38 (37) in diameter; esophagus short; intestinal bifurcation in

Figures 1–8. 1. *Tergestia pauca* Freitas and Kohn, 1965, from *Scomberoides commersonianus*, ventrolateral view. 2, 3. *Allobacciger macrorchis* Hafeezullah and Siddiqi, 1970, from *Scolopsis ruppelli*, ventral view; ventral sucker in Figure 3 shown partially. 4. *Paradiscogaster farooqii* Hafeezullah and Siddiqi, 1970, from *Scatophagus argus*, ventral view. 5. *Neoparacryptogonimus sphericus* sp. n., holotype, from *Lutjanus coccineus*, ventral view. 6. *Paracryptogonimus ramadani* sp. n., holotype, from *Lutjanus fulviflamma*, dorsal view. 7. *P. ramadani*, paratype, ventral view showing ventral sucker embedded in body fold. 8. *P. ramadani* oral sucker with circumoral spines, freehand sketch.

anterior body third; ceca extending to near posterior end of body. Testes symmetrical, 63–78 (75) in diameter, globular to slightly ovoid, in posterior body third, each occupying almost one-third of width. Cirrus sac cylindrical to pyriform, containing ovoid to oblong seminal vesicle, short prostatic duct surrounded by few prostate cells, and nonspiny protrusible cirrus. Ovary 3 separate, spherical lobes, each about same size as pharynx, anterodorsal to and often contiguous with right testis; seminal receptacle poorly defined, dorsal to vitelline reservoir; uterus voluminous, with descending, lateral, and ascending coils filling most of hindbody: metraterm consisting of globular posterior vesicle and muscular cylindrical anterior segment. Vitellaria in 2 lateral clusters of several large extracecal follicles, in forebody, extending from near level of oral sucker to just anterior to ovarian level. Eggs numerous, 18–20 × 10–13 (19 × 12). Genital atrium large, between intestinal bifurcation and ventral sucker; pore postbifurcal. Excretory vesicle V shape, arms extending medially to midacetabular level; pore terminal.

HOST: \**Scolopsis ruppelli* Cuvier, 1830 (Nemipteridae).

SITE IN HOST: Intestine.

DEPOSITED SPECIMENS: NRC No. 26, USNPC No. 87743, BM(NH) No. 1998.3.6.2-3, HWML No. 39704.

REMARKS: The genus *Allobacciger*, erected by Hafeezullah and Siddiqi (1970) for *A. macrorchis* Hafeezullah and Siddiqi, 1970, from *Scolopsis vosmeri* (Bloch) from India, was compared with and distinguished from *Bacciger* Nicoll, 1914, and *Pseudobacciger* Nahhas and Cable, 1964, by a uterus terminating "in a spherical dilation filled with sperms followed distally by a short, highly muscular metraterm and lateral pretesticular ovary comprised of three separate, large, and spherical lobes." The structure of the metraterm in *Allobacciger* suggests a certain similarity to monorchids with a bipartite terminal organ. The absence of spines in the cirrus and/or the metraterm rules it out. Furthermore, in all well-described species of monorchids with bipartite terminal organ, the uterus enters the terminal organ at some point anterior to the posterior vesicle and not at its posterior end. Our specimens from a related host agree well with the description of Hafeezullah and Siddiqi's 5 specimens, differing only in their smaller size (almost half) and shorter prephar-

ynx and esophagus. This finding represents a new locality record.

*Paradiscogaster farooqii*  
Hafeezullah and Siddiqi, 1970

(Fig. 4)

DESCRIPTION (based on 19 specimens): Body somewhat fusiform with rounded ends, 1,125–1,920 × 300–675 (1,352 × 454) at level of ventral sucker. Forebody 28–35% (32%) of body length, hindbody 35–49% (42%). Tegument spinose; spines extending to near posterior end of body. Eye-spot pigments absent. Oral sucker subterminal, 140–180 (154) in diameter. Ventral sucker in midbody, 280–530 × 180–370 (428 × 282) exclusive of its 4 semicircular papillae. Sucker ratio 1:2.1–1:2.8 (1:2.7). Prepharynx absent or very short; pharynx 37–67 × 45–72 (45 × 60); esophagus approximately 1/7–1/8 body length; ceca short, saclike, not reaching ventral sucker. Testes 120–170 × 95–110 (146 × 100), symmetrical to subsymmetrical, globular to ovoid, immediately posterior to, sometimes contiguous with, ventral sucker. Cirrus sac, 230–300 × 75–120 (280 × 90) wide, median, slightly overlapping anterior level of ventral sucker. Ovary 75–120 (101) in diameter, spherical to subspherical, immediately posterior to ventral sucker, often intertesticular; seminal receptacle 82–200 (138) in diameter, posterior to and overlapping ovary; uterus extending laterally and posteriorly to near end of body. Vitelline follicles typically in 4 lateral clusters of 3–9 follicles each; 2 anterior clusters overlapping ceca and 2 posterior ones extending from near posterior level of ventral sucker to level of testes. Eggs 25–33 × 15–20 (28 × 17). Excretory vesicle V shape, arms extending anteriorly to posterior level of ceca; pore terminal.

HOST: *Scatophagus argus* Linnaeus, 1766 (Scatophagidae).

SITE IN HOST: Intestine.

DEPOSITED SPECIMENS: NRC No. 21, USNPC No. 87744, BM(NH) No. 1998.3.6.4, HWML No. 39705.

REMARKS: This is the third report of *Paradiscogaster farooqii*; the measurements and descriptions are in general agreement with those of Hafeezullah and Siddiqi (1970) from the same host in India. Bray (1984) reported this species from *Monodactylus argenteus* (Linnaeus) (Monodactylidae) from Sodwana, Natal; Bray's figure, apparently due to contraction, does not

show the typical distribution of the vitelline follicles seen in Hafeezullah and Siddiqi and the Kuwaiti specimens. The Kuwaiti material keys out quite well to this species using Bray (1984) but to *P. glebulae* Bray et al., 1994, in Bray et al. (1994). Bray noted some differences between the Sodwana and the Indian specimens relating to esophageal length, length and extent of the ceca in relation to the ventral sucker, and the presence of spines. In our specimens, the esophagus is longer than the ceca but shorter than that described by Hafeezullah and Siddiqi. In some specimens, the ceca overlap the anterior level of ventral sucker. The tegument is spiny, with spines extending to the posterior end of the body. The posterior extent of the cirrus sac varies from anterior level to midlevel of the ventral sucker. Mehlis' gland is dextralateral to the ovary. Hafeezullah and Siddiqi described the ventral sucker as "discoid and emarginate." These authors used the same terms to describe the ventral sucker of another species, *Odontocotyle (Odontotrema) arabii* Hafeezullah and Siddiqi, 1970, whose figure has distinct semicircular papillae similar to those in our *P. farooqii* (Fig. 4). The ventral sucker in most of our specimens is, however, like those figured for the Indian and Sodwana material. We are certain that all our specimens belong to the same species. In a few specimens, 2–3 follicles are seen laterally on each side at midacetabular level. A vitelline distribution in which the follicles extend from the anterior level of the ventral sucker to its posterior level is characteristic of *Discogasteroides* Strand, 1934. The species in the genera *Paradiscogaster* Yamaguti, 1934, *Discogasteroides*, and *Pseudodiscogasteroides* Gupta, 1955, show overlapping characteristics. Bray et al. (1994) present an excellent review of the group. This finding in the Arabian Gulf represents a new locality record.

### Cryptogonimidae

#### *Neoparacryptogonimus sphericus* sp. n.

(Fig. 5)

**DESCRIPTION** (based on 5 specimens, 1 sectioned): Body almost spherical to ovoid, 535–770 × 423–616 (640 × 538), widest at level of testes. Forebody 30–33% of body length, hindbody 60–65%. Tegument spinose; spines embedded in thick tegument, extending to posterior end of body. Eye-spot pigments present. Cephalic glands numerous, around oral-pharyngeal

area. Oral sucker terminal, 113–160 × 144–209 (128 × 183); circumoral spines up to 80, in 1 uninterrupted circle, each spine about 12 × 4. Ventral sucker 61–76 × 61–90 (69 × 74), in anterior body third, embedded in cuticular fold. Sucker ratio 1:0.40–1:0.54 (1:0.47). Gonotyl absent. Prepharynx absent; pharynx 46–57 × 51–57 (53 × 55); esophagus absent; ceca bifurcating in anterior body fifth, extending to near posterior end of body. Testes 141–143 × 143–144 (142 × 143), spherical to ovoid, symmetrical to sub-symmetrical, intercecal to partly cecal, near midbody; seminal vesicle bipartite, consisting of 2 spherical segments, each as large as ventral sucker, overlapping its anterior border; prostatic duct and cirrus short. Posttesticular space 45–50% body length. Ovary median, multilobed (20–30 lobes), posttesticular and overlapping posterior edge of testes, occupying 30–35% of body width; seminal receptacle ovoid, immediately anterior to ovary, often concealed by uterine coils; Laurer's canal not seen; ootype–Mehlis' gland barely visible, concealed by seminal receptacle; uterus with descending, lateral, and ascending coils extending to extracecal space. Vitelline follicles mostly extracecal, extending from near posterior level of testes to about midway between ovary and posterior end of body. Eggs 18–24 × 12–16. Genital pore within ventrogenital sac, surrounded by weakly developed muscle strands. Excretory vesicle Y shape, arms extending to level of intestinal bifurcation.

**TYPE HOST:** *Lutjanus coccineus* Cuvier and Valenciennes, 1828 (Lutjanidae).

**OTHER HOST:** *Batrachus grunniens* Linnaeus, 1758 (Batrachoididae).

**SITE IN HOSTS:** Intestine.

**HOLOTYPE:** NRC No. 27.

**PARATYPES:** USNPC No. 87740, BM(NH) No. 1998.3.6.5.

**ETYMOLOGY:** The species name reflects the body shape of the worm.

**REMARKS:** This species was placed in the genus *Neoparacryptogonimus* based on Hafeezullah's (1975) revision of the genus *Paracryptogonimus* Yamaguti, 1934; he used the distribution of the vitellaria as a criterion to erect the genus *Neoparacryptogonimus*, to which he transferred *P. ovatus* Yamaguti, 1952, *P. rostratus* Nagaty and Abdel Aal, 1961, *P. saccatus* Manter, 1963, and *P. orientalis* Fischthal and Kuntz, 1964. Hafeezullah argued that differences in pattern of distribution of vitelline fol-



licles had already been used to distinguish the cryptogonimidlike genera *Metadena* Linton, 1910, *Pseudometadena* Yamaguti, 1952, and *Neometadena* Hafeezullah and Siddiqi, 1970. He distinguished *Neoparacryptogonimus* from *Paracryptogonimus* chiefly by vitelline follicles that are "lateral to testes, protruding into pre- and post-testicular lateral fields," in contrast with follicles that are "essentially pre-testicular in lateral or dorsolateral fields." We have reviewed the description of the species that he included in his revision and those described since then and tend to agree that they do fall into 2 distinct groups with almost no overlap.

The only other species in the *Paracryptogonimus-Neoparacryptogonimus* complex with posttesticular ovarian lobes is *N. saccatus* (Manter, 1963) from which *N. sphericus* sp. n. may be distinguished by the absence of a uterine sac, the distribution of the vitelline follicles, and size, shape, and location of the seminal vesicle.

***Paracryptogonimus ramadani* sp. n.**

(Figs. 6–8)

**DESCRIPTION** (based on 10 specimens): Body ovoid, 691–1,408  $\times$  320–666 (906  $\times$  504), widest at level of testes. Forebody 25–30% of body length; hindbody 50–75%. Tegument spinose; most spines lost. Eye-spot pigments present. Cephalic glands numerous, in oral-pharyngeal area. Oral sucker terminal, 80–128  $\times$  70–154 (92  $\times$  113); circumoral spines up to 60, in 1 uninterrupted circle, each spine about 11  $\times$  5; spines lost in many specimens. Prepharynx absent or very short; pharynx 33–64  $\times$  33–76 (46  $\times$  49); esophagus absent or very short; intestinal bifurcation about midway between pharynx and ventral sucker; ceca extending to near posterior end of body. Ventral sucker 60–90 (71) in diameter, embedded in cuticular fold, posterior to intestinal bifurcation. Sucker ratio 1:0.45–1:0.72 (1:0.52). Gonotyl absent. Testes 166–200  $\times$  130–180 (186  $\times$  147), symmetrical to subsymmetrical, ovoid, overlapping ceca, in posterior half of body; seminal vesicle bipartite, each part spherical, overlapping posterior border of ventral sucker; pars prostatica poorly developed, cirrus short. Posttesticular space 20–25% body length. Ovary median, consisting of 20–30 lobes, just anterior to and slightly overlapping testes, occupying about one-third body width; seminal receptacle spherical, between seminal vesicle and anterior level of ovary; Laurer's canal not seen;

ootype–Mehlis' gland anterodorsal to ovary concealed by seminal receptacle; uterus with descending and ascending coils extending lateral to ceca, occupying most of hindbody. Vitelline follicles lateral, extending from anterior level of testes to midlevel of ventral sucker, rarely reaching its anterior border. Eggs 15–25  $\times$  9–15 (20  $\times$  12). Genital pore within ventrogenital sac, surrounded by circular muscle. Excretory vesicle Y shape, anterior extent of arms not observed.

**TYPE HOST:** *Lutjanus fulviflamma* Forsskål, 1775 (Lutjanidae).

**SITE OF INFECTION:** Intestine.

**HOLOTYPE:** NRC No. 28.

**PARATYPES:** USNPC No. 87741, BM(NH) No. 1998.3.6.6, HWML No. 39706.

**ETYMOLOGY:** This species is named for Professor M. M. Ramadan in recognition of his contributions to the knowledge of digeneans of the Red Sea and the Arabian Gulf.

**REMARKS:** This species is most similar to *P. aloysiae* (Stossich, 1899) Bartoli and Gibson, 1995, *P. americanus* Manter, 1940, *P. neoamericanus* Siddiqi and Cable, 1960, and *P. sootai* Hafeezullah, 1975. It differs from *P. aloysiae* in body shape, with length greater than 2 times width; the testes are longitudinally rather than transversely ovoid and are in more anterior extent of vitelline follicles. *Paracryptogonimus ramadani* sp. n. differs from *P. americanus* and *P. neoamericanus* in its relatively larger testes, more anterior extent of the vitelline follicles, and globular bipartite seminal vesicle; from *P. sootai*, it is distinguished by its smaller sucker ratio, relatively smaller testes, and smaller eggs.

Saoud et al. (1988a) described *Allacanthochoasmus lutjani* from *Lutjanus fulviflamma* from coastal waters of Qatar, Arabian Gulf. This trematode has a superficial resemblance to *P. ramadani* but may be distinguished from it by somewhat more anterior vitelline follicles, fewer circumoral spines, intertesticular ovary, and presence of a gonotyl. *Allacanthochoasmus* is a freshwater cryptogonimid genus; its 2 previously known species, *A. varius* Van Cleave, 1922, and *A. artus* Mueller and Van Cleave, 1932, were described, respectively, from the Mississippi River and adjacent lakes and Oneida Lake. The occurrence of a marine species, *A. lutjani*, assigned to a North American freshwater genus in a distant place, such as Qatari waters in the Arabian Gulf, is unusual and unexpected.



The addition of the 2 new taxa reported in this paper brings the total to 33 nominal species assigned to the genera *Paracryptogonimus* and *Neoparacryptogonimus*, 28 in the former and 5 in the latter: *Paracryptogonimus acanthostomus* Yamaguti, 1934; *P. americanus* Manter, 1940; *P. apharei* (Yamaguti, 1942) Velasquez, 1961; *P. mexicanus* Bravo-Hollis, 1956; *P. macrospinus* Caballero, Hidalgo and Grocott, 1956; *P. leilae* (Nagaty, 1957) Manter, 1963; *P. neoamericanus* Siddiqi and Cable, 1960; *P. centriopomi* Siddiqi and Cable, 1960; *P. manilensis* Velasquez, 1961; *P. echinostomus* (Oshmarin, Mamaev and Parukhin, 1961) Yamaguti, 1971; *P. hirastrictus* Manter, 1963; *P. morosovi* (Parukhin, 1965) Yamaguti, 1971; *P. ghanensis* Fischthal and Thomas, 1968; *P. yamagutii* Lamothe-Argumedo, 1969; *P. provitellosus* Durio and Manter, 1969; *P. longitestis* Durio and Manter, 1969; *P. cata-lae* Durio and Manter, 1969; *P. testitactus* Durio and Manter, 1969; *P. apharei* Yamaguti, 1970; *P. muscularis* Yamaguti, 1970; *P. onaga*, Yamaguti, 1970; *P. ula ula* Yamaguti, 1970; *P. sootai* Hafeezullah, 1975; *P. elongatus* Gu and Shen, 1979; *P. lutiani* Wang, 1991; *P. aloysiae* (Stossich, 1885) Bartoli and Gibson, 1995; *P. xiamenensis* Liu, 1996; and *P. ramadani* sp. n.; *Neoparacryptogonimus ovatus* Yamaguti, 1952; *N. rostratus* Nagaty and Abdel Aal, 1960; *N. saccatus* Manter, 1963; *N. orientalis* Fischthal and Kuntz, 1964; and *N. sphericus* sp. n. The status of some species is uncertain: *P. apharei* (Yamaguti, 1942) was described as *Siphoderina apharei*, from *Aphareus furcatus* (Lutjanidae) from Naha, Okinawa, Japan, and later was transferred to *Metadena* by Yamaguti (1953). Velasquez (1961) recovered 4 specimens from *Lutjanus* sp. from Malabon, Luzon Island, the Philippines, which she considered very similar to those of Yamaguti except for the presence of circumoral spines, and transferred it to *Paracryptogonimus*; this transfer was accepted by Lamothe-Argumedo (1969) and Hafeezullah (1975). Yamaguti (1971) made no reference to Velasquez (1961) when he transferred it to *Pseudosiphoderoides* Yamaguti, 1958. Since Velasquez's material was not obtained from the same host species and locality, we prefer to accept Yamaguti's classification. *Paracryptogonimus leilae* from *Lethrinus rostratus* from the Red Sea was returned to the genus *Metadena* by Ramadan according to Saoud et al. (1988a) on the basis that the genus *Metadena*, which has no cir-

cumoral spines, "could be separated from *Paracryptogonimus* by the presence of numerous dermal glands in the anterior part of the body, and by the extension and topography of the vitelline follicles." Manter (1963) had studied 2 paratypes of this species and found them to have small circumoral spines. Saoud et al. (1988a), who recovered 2 mature and 5 immature specimens from *Lutjanus fulviflamma* from Qatari waters, agreed with Ramadan "noticing the absence of the crown of oral spines in living specimens." In our opinion, *P. leilae* is very similar to *P. ghanensis* Fischthal and Thomas, 1968, from *Lutjanus guineensis* from Ghana except for slightly less anterior extent of vitelline follicles; for the time being, we will retain its validity based on Manter's examination of paratypes. According to Saoud et al. (1988a), Ramadan also transferred *P. rostratus* to *Metadena*. Manter (1963) had considered it a synonym of *P. ovatus*, with which we agree, and we currently accept it in the genus *Neoparacryptogonimus*. The slight differences between *P. americanus* and *P. neoamericanus* led Overstreet (1969) to consider the latter a synonym of the former. We restudied 1 specimen of *P. neoamericanus* collected from *Ocyurus chrysurus* from Curaçao and tend to agree. *Paracryptogonimus lutiani* Wang, 1991, is the only species assigned to this genus with an entire ovary. It is not adequately described but is retained, for the time being, in *Paracryptogonimus* considering variability in lobation of the ovary in the group, with a few species having 3–5 lobes but most with multi-lobed ovaries. The only other genus of cryptogonimids with a single ovary is *Mahrosa* Nagaty and Abdel Aal, 1961, which was considered *nomen nudum* by Manter (1963). Liu (1996) described the testes of *P. xiamenensis* as symmetrical or diagonal. His figure shows what we interpret as subsymmetrical, which places it close to *P. ula ula*; if arrangement of testes is considered diagonal, it comes close to *P. manilensis*, from which it may be distinguished by a less elongated body, ovoid rather than elongated testes, shorter ceca, and larger eggs ( $19-30 \times 11-14$  compared with  $14.5-16 \times 7-9.5$ ).

A key to the 30 species of *Paracryptogonimus* and *Neoparacryptogonimus* that we recognize in this paper, including the 2 new ones from Kuwait, follows.

# Key to the Species of *Paracryptogonimus* and *Neoparacryptogonimus*

- 1a. Vitelline follicles lateral to testes, protruding into pre- and posttesticular fields ..... *Neoparacryptogonimus*, 2
- 1b. Vitelline follicles lateral or dorsolateral, chiefly in pretesticular fields ..... *Paracryptogonimus*, 5
- 2a. Oral sucker smaller than ventral sucker; sucker ratio 1:1.41; testes symmetrical, intercecal, in posterior half of body; seminal vesicle thin walled, somewhat saccular, dorsal to anterior two-thirds of ventral sucker; ovary 4 lobed, left lobe separated from others by uterine coil; eggs 17–18 × 8–9; circumoral spines 74–80 ..... *N. orientalis*
- 2b. Oral sucker as large as or larger than ventral sucker ..... 3
- 3a. Suckers equal or subequal; testes spherical, near midlevel of body or slightly more posterior; seminal vesicle tubular, winding, from near midbody to left side of anterior level of ventral sucker; ovary 3–4 lobes, pretesticular; vitelline follicles extending laterally from level of seminal vesicle to near end of ceca; circumoral spines about 80 ..... *N. ovatus*/*N. rostratus*
- 3b. Oral sucker about twice the size of the ventral sucker; ovary multilobed, unless degenerate, posttesticular ..... 4
- 4a. Uterine sac present ..... *N. saccatus*
- 4b. Uterine sac absent ..... *N. sphericus* sp. n.
- 5a. Testes symmetrical or subsymmetrical ..... 6
- 5b. Testes diagonal ..... 18
- 6a. Ovarian lobes less than 5; vitelline follicles extending laterally from posterior level of ventral sucker to esophageal-pharyngeal level; sucker ratio 1:0.47; circumoral spines 135 ..... *P. provitellosus*
- 6b. Ovarian lobes more than 5 ..... 7
- 7a. Body length less than twice ..... 8
- 7b. Body length more than twice ..... 9
- 8a. Sucker ratio 1:0.79–1:0.90; testes usually transversely ovoid, small, occupying less than one-third body width; ovary intertesticular; vitelline follicles extending between anterior border of ovary and intestinal bifurcation; terminal end of ceca swollen; circumoral spines 78 ..... *P. aloysiae*
- 8b. Sucker ratio 1:0.25–1:0.38; testes large, occupying more than two-thirds body width; ovary anterior to testes; vitelline follicles lateral, extending from anterior level of testes to near intestinal bifurcation; terminal end of ceca not swollen; circumoral spines present but many lost ..... *P. sootai*
- 9a. Vitelline follicles restricted to gonadal-acetabular level ..... 10
- 9b. Vitelline follicles more extensive reaching to at least anterior level of ventral sucker ..... 12
- 10a. Body elongate, length at least 2.5× width; ovary near midbody, far removed from testes; circumoral spines 37–39 ..... *P. macrospinus*
- 10b. Body ovoid to plump; length less than 2.5× width; ovary close to testes ..... 11
- 11a. Testes large, occupying almost two-thirds body width; vitelline follicles reaching mid- or anterior level of ventral sucker; seminal vesicle globular, bipartite ..... *P. ramadani* sp. n.
- 11b. Testes relatively small; vitelline follicles barely reaching posterior level of ventral sucker ..... *P. americanus*/*P. neoamericanus*
- 12a. Body length more than 3× width; gonads in posterior half of body; seminal vesicle tubular, entirely anterior to ventral sucker; vitelline follicles lateral, in midbody; ovary close to testes; circumoral spines 74–102 ..... *P. yamagutii*
- 12b. Body length less than 3× width ..... 13
- 13a. Vitelline follicles extending from anterior level of testes to anterior level of ventral sucker; testes extracecal, at or just anterior to midbody; seminal vesicle bipartite; circumoral spines 64; sucker ratio 1:0.78 ..... *P. centropomi*
- 13b. Vitelline follicles extending to at least intestinal bifurcation ..... 14
- 14a. Testes elongate, their length 2× width, extracecal, mostly in posterior body third; ovary in midbody, well removed from testes; sucker ratio 1:0.46–1:0.50; ceca converging in posterior body third ..... *P. longitestis*
- 14b. Testicular length less than twice width; testes overlap ceca ..... 15
- 15a. Testes ovoid ..... 16
- 15b. Testes elongate ..... 17
- 16a. Oral sucker slightly larger than ventral sucker; transverse sucker ratio 1:0.73; circumoral spines 42–58 ..... *P. ula ula*
- 16b. Oral sucker much larger than ventral sucker; transverse sucker ratio 1:0.59; circumoral spines 55 ..... *P. xiamenensis*
- 17a. Testes diagonally elongate; vitelline follicles extending to pharyngeal level; sucker ratio 1:0.65; circumoral spines 70–75 ..... *P. ghanensis*
- 17b. Testes longitudinally elongate; vitelline follicles extending to intestinal bifurcation; number of circumoral spines unknown ..... *P. leilae*
- 18a. Ovary entire; testes globular, large; vitelline follicles extending from posterior level of seminal vesicle to just anterior to intestinal bifurcation; sucker ratio 1:0.74; circumoral spines 58–60 ..... *P. lutiani*
- 18b. Ovary lobed ..... 19
- 19a. Testes entire or slightly indented ..... 20
- 19b. Testes usually deeply incised ..... 28
- 20a. Ventral muscular pads present in acetabulo-pharyngeal region; sucker ratio 1:0.68; circumoral spines up to 55; ovary rosette shaped; vitelline follicles in 4–5 bunches between midovarian level and ventral sucker ..... *P. muscularis*
- 20b. Ventral muscular pads absent ..... 21
- 21a. Body elongate, length 5–7× width ..... 22

- 21b. Body ovoid to plump, length less than 5× width ..... 23
- 22a. Body length 5× width; posttesticular space about one-sixth body length; circumoral spines 21–27; sucker ratio 1:0.48 ..... *P. elongatus*
- 22b. Body length at least 6.5× width; posttesticular space one-third body length; sucker ratio 1:0.83 ..... *P. mexicanus*
- 23a. Testes contiguous, anterior testis intercecal; uterus extending lateral to ceca; sucker ratio 1:0.7; vitelline follicles between anterior testis and posterior level of ventral sucker; circumoral spines 42–46 ..... *P. testitactus*
- 23b. Testes separated by uterine coils ..... 24
- 24a. Testes intercecal, either testis more anterior; body ovoid; uterus intercecal; sucker ratio of transverse diameter 1:0.62; circumoral spines 56–58 ..... *P. catalae*
- 24b. Testes overlap ceca ..... 25
- 25a. Vitelline follicles extending from ovarian level to near intestinal bifurcation; testes large, elongate; circumoral spines not determined; sucker ratio 1:0.49 ..... *P. manilensis*
- 25b. Vitelline follicles not extending anterior to ventral sucker ..... 26
- 26a. Vitelline follicles extending anteriorly to level of ventral sucker and inward, meeting or almost meeting medially; ovarian lobes not tightly compact; excretory canals not extending anterior to pharynx; circumoral spines 80–94 ..... *P. hirastrictus*
- 26b. Vitelline follicles not close medianly; circumoral spines 49–58 ..... 27
- 27a. Testes ovoid, partially extracecal; intestinal ceca converge medially in area between testes; ovarian lobes compact, rosette shape; circumoral spines 49 ..... *P. acanthostomus*
- 27b. Testes oval-elliptical, occasionally with lateral incisions, mostly intracecal; ovary rosette shaped; vitelline follicles in several bunch-like clusters between midlevel of anterior testis and posterior level of ventral sucker; circumoral spines 49–58 ..... *P. onaga*
- 28a. Vitelline follicles extending from midovarian level short distance anterior to ventral sucker but not reaching intestinal bifurcation ..... *P. echinostomus*
- 28b. Vitelline follicles not extending anterior to ventral sucker ..... 29
- 29a. Ovary rosette shaped, large, occupying almost half body width; circumoral spines 38–44 ..... *P. aphareii*
- 29b. Ovary relatively small, occupying about one-fifth of body width ..... *P. morosovi*

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